

Official Telecopy

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

DATE: SEP 12 1997

SUBJECT: Plant Inspection
Metropolitan Wastewater Treatment Plant
2400 Childs Road
St. Paul, Minnesota

FROM: Lynn Kuo, Engineer
Air Enforcement and Compliance Assurance Section
(MN/OH)

Section Chief Initials WRM

TO: Files

Inspection Date: August 19, 1997

Participants: Lynn Kuo, U.S. Environmental Protection Agency
(EPA)
Denny Dart, U.S. EPA

Jim Brown, Principal Process Engineer
Rebecca Flood, Regulatory Compliance Manager

1. Purpose:

The purpose of this inspection was to assess compliance at the Metropolitan Wastewater Treatment Plant (MWTP) owned and operated by the Metropolitan Council (MC). The main issue was determining whether construction of a major modification had begun without the appropriate permit for incinerator 8. We had to determine what changes had been made, whether a significant net emissions increase occurred due to the changes, and when the changes were made. In addition, we wanted a better general understanding of the flow process, the facility layout, the emergency stack and

damper system¹, causes of damper leakage and bypass usage, and remedies considered and attempted by MC.

2. General Process Description:

MWTP is a secondary wastewater treatment facility which processes approximately 250 million gallons of wastewater per day, approximately 30% from industrial sources. MWTP conditions and dewateres primary and secondary sludge and incinerates the sludge in the facility's six multiple hearth incinerators (numbered 5-10). Exhaust from each incinerator passes through a separate air pollution control system consisting of a precooler, high pressure Venturi scrubber, subcooler, and demister. The air pollution control system on incinerators 7-10 also include a quad cyclone and heat recovery boiler prior to the precooler. Under typical conditions, four of the six incinerators will be in operation; operations continue 24 hours a day, 7 days a week. Recently two centrifuges have been installed at the facility to be tested as possible dewatering devices for the future. In addition to the incinerators, there are eight other sources of particulate matter: two auxiliary natural gas/fuel oil boilers and six ash handling systems equipped with baghouses and vented to separate stacks.

3. Recent History:

Minnesota Pollution Control Agency (MPCA) inspected MWTP on September 26, 1995, and August 17, 1994, and reported it found the facility to be in compliance during the inspection on both occasions. The 1994 inspection report included notation that MWTP did not have an odor test plan or operation and maintenance plan for the incinerators as required by the permit. U.S. EPA inspected on September 11, 1996 in order to assess compliance of PM-10 emission limits and emergency damper usage.

On June 5, 1995, MWTP failed a particulate matter stack test on incinerator 10. MPCA issued a notice of non-compliance on August

¹ Note that relief stack or relief damper is the same as emergency stack or damper. MC tends to use the term relief stack.

30, 1995, and an Administrative Penalty Order (APO) on February 16, 1996. MWTP paid a \$2,500 penalty on February 29, 1996, and received a satisfaction letter from MPCA on March 6, 1996. On June 18, 1996, MWTP failed a particulate matter stack test on incinerator 7. Incinerator 7 was retested on September 18, 1996 and found to be in compliance. The MPCA has deferred enforcement to the U.S. EPA. On July 16, 1997, U.S. EPA issued a Finding Of Violation (FOV) and a Notice Of Violation (NOV) to MC for a number of different violations related to excess particulate matter (PM-10) emissions, reporting violations, and excessive emergency damper usage.

MWTP reported in late August 1995 to the MPCA that leakage of incinerator exhaust gas past emergency dampers that lead to the emergency stacks was occurring. More discussion of MWTP's attempts to control and eliminate this problem are discussed below.

4. Pre-Inspection Discussion:

History and Background Information

The inspection was announced several days in advance. Driving on Childs Road, we detected a strong odor 1/4 mile from the plant. We arrived around 10:30 and were met by Jim Brown, the principal process engineer and Rebecca Flood, the Regulatory Compliance Manager. We showed them our credentials, and for the next couple hours they discussed the history of MC and the MWTP, flow processes at MWTP, problematic issues related to the FOV/NOV and possible solutions at the facility.

Ms. Flood began by discussing the history of MC. In 1969 MC was formed. An operation commission was formed a year later in 1970, and the sewer board became a part of MC and was called the waste control commission. At that time there were 33 sewage plants which discharged into the lakes and other water bodies. Presently there are 9 plants set up in a regional system; the MWTP is the largest facility processing 250 million gallons of wastewater per day. Of these 9 facilities, 8 are major and 1 is minor. In 1994, the legislature combined MC and the operation commissions to control transportation, community development and waste (which is called the Environmental Services Division). MC,

a non-for-profit, government agency, consists of 17 members, including a chairperson, all of which are appointed by the governor. Money comes from 105 towns and approximately 900 permitted industrial users.

Local collection lines start at house lines, then go to community lines and eventually end up in the large pipes running alongside Childs Road (large enough to drive a semi truck inside). The plant was built in 1938 for primary treatment only and was enhanced in the 50's and 60's to perform secondary treatment. The plant was and still is able to address treatment issues, such as the removal of solids, BOD, phosphorus, chlorination, and dechlorination. In 1974, flood protection was completed on the facility.

In Minnesota, a number of different facilities handle raw waste. MC manages another facility called Seneca, similar to the MWTP except about 1/10 in size. The raw waste is either sent to landfills, to dewatering plants and then trucked to facilities with incineration capabilities, or to facilities that dewater and incinerate, such as the MWTP and Seneca.

The process flow at the MWTP begins with dewatering raw waste. The primary sludge is first treated to remove organics. Bacteria eat the insoluble organics. To support the bacteria, aeration is needed. As they multiply, the bacteria die and need to be disposed of (approximately 10% or 100 dry tons per day of solids at the MWTP). After the organic treatment, the sludge contains 1% solids and needs to be thickened to 6%, the consistency of a milkshake. Once this is done, the sludge is dewatered through vacuum filters, roll presses, plate-in-frame presses and centrifuges. The dewatered sludge (also called cake) contains 30-32% solids, has the consistency of wet mud, and can now be incinerated. Approximately 220 dry tons per day of sludge are incinerated at the MWTP, producing 55 tons of ash per day. The ash is then stored and hauled for use in cement manufacturing. Approximately 3-4 (5-10% of total) tons of ash per day are mixed with lime to produce the fertilizers N-Viro soil and NutraLime. These piles of fertilizer are stored on pads outside.

The waste heat recovery boilers heat the plant and run some of the process equipment. The MN SIP regulates the 2 auxiliary boilers that burn natural gas or #2 fuel. These burners are used

to supply heat and energy in the winter when the waste heat recovery system cannot supply enough. The choice of fuels is determined by the demand of natural gas usage on the supplier. Mr. Brown commented that the MWTP has recently had to use #2 fuel more than usual, most likely due to higher demand of natural gas by other customers.

In 1982, the incinerators were replaced. The multiple hearth incinerators presently in place are 45 feet tall and 22 feet in diameter. They consist of a metal shell, wool insulation, brick lining, and shelves or ledges. Each incinerator has nine hearths, described as shelves, numbered 0 through 8 starting from the top. Some hearths are double-sized; these are used for drying the sludge as it travels through the top hearths (see page 3 of attachment 1). The multiple hearth incinerator is known as a counter-current heat exchanger, in which sludge travels down and gases come up. The sludge is fed from the top where it drops straight down to hearth 1, passing hearth 0. Hearth 0 functions as an afterburner, which is used mainly to raise the temperature of the gas to the required exit temperature (see page 6 of attachment 1). Through the center of the incinerator is a 80-90 ton metal shaft rotating at 1 revolution per minute. Connected to this shaft are rabble arms which rake the ash and sludge along the hearths (see page 4 of attachment 1). The nine hearths make up three process zones for drying, burning and ash cooling. Hearth 0 combusts VOCs; however, CO emissions are a problem, one of the negative aspects of the multiple hearth system. Once the sludge is dried to 55% solids at hearths 1-3, it can be burned in lower hearths. Ignition point is usually on hearth 3 (1700 degrees Fahrenheit) or 4, and by hearth 6 the sludge has mostly burned into ash. Cool air is injected into hearth 3 to maintain the correct temperature. The flue gas exhaust exits from the top of the incinerator at approximately 80,000 acfm and 1200 degrees Fahrenheit. To protect the center shafts and rabble arms from damage due to heat, cool air flows through the hollow center shaft and exits at a temperature of 200 degrees Fahrenheit. Depending on the particular incinerator, the heated air is either recirculated into the building (incinerators 5-8) or vented outside.

Two centrifuges have been installed and have been operating for approximately one month. Initially, MC was expecting a cake solid percentage of 23 to 24%. In order to burn off the water in

the wetter cake, MC had proposed to relocate the burners in incinerator 8 and install larger burners. However through testing they have discovered that the cake has been between 28 and 35% solids. The two centrifuges can feed to all incinerators or just incinerator 8; presently the centrifuge cake is being fed to all incinerators. MC is currently testing the centrifuge dewatering system in order to replace the present system which involves two parts: Zimpro and one of the several mechanical presses or filters. In order to dewater, the cell walls of the dead bacteria need to be "popped" somewhat analogous to a balloon. The mechanical presses or filter do not apply near enough pressure to break these microscopic walls. For this reason, Zimpro, a process which involves wet air oxidation and thermal conditioning (somewhat like a high pressure cooker), is required for dewatering. In addition to requiring high maintenance and energy, the Zimpro process is aging and needs to be replaced. Centrifuges which provide a force of 2500 gravities can break these cell walls and dewater effectively with less complex technology. When asked whether dewatering is a bottleneck or if centrifuges provide more dewatering capacity, Mr. Brown informed us that centrifuges would actually provide less capacity compared to the present system and that the bottleneck in the process is liquid storage.

In addition to the centrifuge system, they have been testing different polymers used to thicken the sludge. Solids carry a negative charge so to prevent repulsion, polymers, which are long chains carrying positive charge, are mixed in.

Discussion of Damper Usage and Bypass

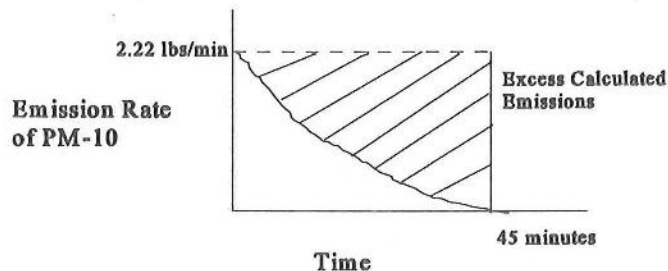
The FOV/NOV issued by the U.S. EPA contains violations related to the use of emergency stacks and leakage past the emergency damper. For the past four years, over 200 breakdowns have occurred each year causing the emergency damper to open and uncontrolled emissions to exit the emergency stack. Leakage of uncontrolled emissions has also been occurring for the last two years and possibly more. One of the main reasons for conducting this inspection was to learn more about the cause of the breakdowns and leakage and possible solutions to these problems. The MWTP facility is in a moderate nonattainment area for PM-10, therefore it is crucial to address the PM-10 sources.

In the event of some type of breakdown, the emergency damper opens, a loud alarm is triggered, the off-gas damper closes, sludge feed stops, and the remaining sludge in the incinerator continues to combust. The system can only be manually restarted once the emergency damper is closed. (See page 8 of attachment 1) Each incinerator has its own control train, however Incinerator 5 and 6 do not have quad cyclones, economizers, or waste recovery heat boilers. Incinerator 5 and 7 share a relief stack, as do 6 and 8; Incinerator 9 and 10 have their own relief stacks. The relief stacks located on the opposite side of the incinerator from the control train allow natural venting to the atmosphere. Mr. Brown pointed out that the incinerators are not completely closed; therefore to prevent the emissions from venting inside and harming workers inside the building, the emergency stacks are necessary. (See attachment 2)

Mr. Brown discussed the different reasons for breakdown occurrence (see page 10 of attachment 1). About half of the breakdowns that occur are due to the Induced Draft fan failure. These 500 Hp fans need to create a 70 inch water vacuum to pull the exhaust through the entire control train. The ID fans can fail for a variety of reasons, including power failures, high heat conditions, motor overheating, and excessive motor vibrations. These fans receive regular maintenance, however there are no plans to replace them because of the high cost. In addition, Mr. Brown said that larger fans could collapse the duct work due to the age of the facility. In addition to fan failure, there are other circumstances in which breakdown will occur: high flue gas temperatures which can cause damage to the equipment, insufficient pressure of the oil hydraulics which support the rabble arm, or a loss of water pressure to any of the 3 separate inputs of the Venturi system - the precooler, venturi, and subcooler. However there are other unpredictable situations that can also arise. For example, 5 emergency damper openings occurred before the staff operators realized that the tray on the scrubber was lost.

When the damper opens and feed stops, the burnout process takes about 45 minutes, as a conservative estimate; most likely it takes about 30 minutes. Mr. Brown pointed out that the estimate made of stack emissions when burnout occurs assumes that throughout the process, the amount of PM-10 is steadily released at 2.22 lb/min. In reality, however, the emission rate during

burnout actually decreases. The following diagram depicts this difference in calculation.



The MWTP facility can monitor damper opening duration down to the second. Each damper opening, whether it lasts one second or 45 minutes, is recorded and the average duration is 12 minutes.

According to a CO mass analysis conducted by MC, damper leakage is approximately 3% of total emissions. In order to minimize the leakage, MC has tried several different methods, some of which have proved effective and others which have not. One of the reasons for leakage is the pressure differential between hearth 0 of the incinerator and the emergency stack. Pressure gauges have been installed on both sides of the emergency damper and a temperature gauge in the emergency stack. (See page 8 of attachment 1 for a clear diagram of the different components of the entire process) The MWTP operators attempt to maintain a 2 inch pressure differential between hearth 0 of the incinerator and the emergency stack to prevent leakage and ensure efficient use of the ID fans. If the pressure differential starts to decrease (e.g. from -2 inches to -1 inch), air will start to flow towards the emergency stack and leakage will occur; on the other hand, if the pressure differential increases (e.g. from -2 inches to -3 inches, the ID fans do unnecessary work because fresh air which doesn't need to be treated is pulled into the exhaust stream and runs through the control train. Therefore, by maintaining a constant pressure differential of -2 inches between the relief stack and hearth 0 of the incinerator, damper leakage can be minimized. This method has limitations because high drafts occur in the relief stack and the ID fans can not always induce the needed draft to maintain the -2 inch pressure differential.

MC has taken measures to improve the damper seal. The damper is a metal guillotine. When closed, the damper is in contact with a brick ledge, which does not act as a very good seal. In 1996 MC installed a ceramic fiber seat made of crushable material and added a gasket on the top and sides of the damper. These improvements however did not prove effective; the fiber tore off as the guillotine was lowered and raised. The damper still does not seal tightly.

In all incinerators, the hot air that flows through the center shaft of the incinerator and the rabble arms was vented to either the building's HVAC system (incinerators 5-9) or their own emergency stack (incinerators 9 and 10). The staff speculates that the hot air from incinerators 9 and 10 being emitted into the emergency stack was causing additional draft, therefore they decided to reroute the hot air from incinerators 9 and 10 to the outside. In early 1997, they disconnected the lines from incinerator 9 and 10, resulting in a decrease in damper leakage. (See page 16 of attachment 1)

In addition to the hot air in the emergency draft, there is also a problem with wind causing drafts in the 10-foot diameter relief stacks. The stacks cannot be covered because of the airport height requirements. Presently they're testing to see whether adding additional vents at the bottom of the stack will reduce leakage. The theory is that instead of the strong drafts pulling incinerator exhaust from the other side of the damper, air would be pulled from the additional vents.

Discussion of Changes to Incinerator 8

Mr. Brown discussed the changes made to incinerator 8. Of the 16 burners, only 10 are active; 6 have had the wires removed. Two burners have been moved from hearth 0 to hearth 2; two burners had been added to hearth 4 and are presently still wired but locked up. The total maximum capacity of incinerator of 8 is 27 mmbtu/hr. The average operating condition is 7 mmbtu/hr and will at the highest be 15 mmbtu/hr during start up. (See page 18 of attachment 1). After these changes have been made, the maximum capacity has decreased 2 mmbtu/hr.

Overall Particulate Emissions

Mr. Brown stated that there are three emission points: the incinerator, the auxiliary burners and the vacuum pumps. The latter is used for the ash system. Ash is collected in the bottom of the incinerators and the lighter ash goes out with the flue gas. A vacuum pump pulls bottom ash from different points, collects it in a storage silo and then a cyclonic separator removes large particles and a filter removes the small pieces. (See page 19 of attachment 1) Both the auxiliary burners and the vacuum pump stacks have been stack tested.

Future Plans

In the next 7 years, MC is looking to replace the multiple hearths that were built in 1938. They are considering two options: fluidized bed incineration and drying/marketing. The fluidized bed system doesn't require emergency stacks because of the single level design. There is not a large sludge inventory during incineration. For the drying/marketing option, the demand for the product needs to be determined. The goal is to replace the present system, or parts of, by 2005.

5. Facility Inspection:

We started by looking at incinerator 9 which was down for annual maintenance at the time. We looked inside a hearth and could see the rabble arms and then later actually climbed into hearth 0 of incinerator 9. Mr. Brown showed us the damper system, pointing out the fiber-like material that they put on the brick ledge and around the top and sides in order to form a tighter seal around the damper. Because the material was being torn off the top and sides as the damper raised and lowered, they also had installed metal to hopefully support the fiber. This type of seal did not seem to improve leakage. Pass the damper, we walked further into the bypass tunnel and peered up the emergency stack. Mr. Brown then took us to the other side of the incinerator which led to the control train. We saw the 4 divided sections that vented to the quad cyclone. There were large quantities of dust inside and around the incinerator and brick ducts.

Around the incinerators, we were shown the oil hydraulics that controlled many of the mechanical components of the facility, such as the damper systems and the rabble arms. As discussed

above in the pre-inspection discussion, hot air that comes from the center shafts of incinerators 9 and 10 is now vented to the outside rather than the emergency stack. Mr Brown pointed out the location of the old lines and the duct work of the new lines. In early 1997, MC spent about \$15,000 closing off and building ductwork for this project, which has reduced leakage by about 60%. Wind, however, at the height of the stack is still a problem, inducing drafts inside the emergency stack. Presently there is a wind station so operators can monitor wind speed; in addition they can also measure hearth and stack draft.

From the roof, we were able to see most of the plant and also the emission stack points. Upon asking what emissions look like coming from the emergency stack when the burnout procedure starts, they told us that black smoke is emitted and shortly afterwards emissions become lighter. A field office of the MPCA across the river can actually view the MWTP's stacks and observe when black plumes are emitted.

In March of 1996, MC performed CO mass balance tests in the emergency stack. By varying the pressure differential from 0.1 to 0.2 to 0.3, they could measure how the percent leakage varied. There was somewhat of a linear relation. A 0.1 pressure differential produced about 1% leakage, and each one-tenth increase in pressure differential increased leakage by 1%. As Mr. Brown discussed, the leakage is related to the pressure differential and the orifice area. Without knowing how to account for orifice area, they made a liberal leakage estimate of 10%, which is the value used in all the reports and calculations.

We were also shown the ID fans and the control train. In hopes of preventing emergency damper usage caused from overheating of an ID fan motor, we saw a vent installed to blow cool air on the motor. Mr. Brown informed us that installing larger fans may not be able to prevent breakdowns because of the size limitation of the vertical cement hole leading from the fan. Since the beginning of the year, 97 damper openings have occurred. This quantity of emergency damper usage is supposedly common practice for these types of facilities. Emergency bypass time is approximately 0.17% of operating time.

We also saw the two centrifuges that had been installed. They are testing two different brands for their effectiveness on the

raw sewage that the MWTP treats. There were no strong odors. Mr. Brown stated that depending on the make up of the particular raw sewage, scum and grit can cause problems in centrifuges. Each centrifuge costs about \$700,000. There were several men monitoring the operation of the centrifuges. Ms. Flood informed us that they were from the companies that manufactured the centrifuges and that most likely the MWTP operators will not be able to maintain the same operating performance or be able to produce the same dryness of cake as the operators from the manufacturer. Near the centrifuges were several large containers in which different mixes of polymers were being used for testing. Finally we walked through the Zimpro building. Mr. Brown told us that usually many machines are operating at one time making it very noisy inside; however when we walked through there was only one in operation.

There are about 200 operators and 100 maintenance staff. The facility runs 24 hours/day and approximately 50 people work per shift. Approximately \$150,000,000 are allocated a year for all MC plants and the MWTP receives about \$40,000,000, of which a quarter is spent on electricity.

6. Post-inspection Discussion:

We ended by discussing a few issues related to emergency stack usage, notifications made to MPCA, and emergency damper leakage. Mr. Brown stated that they did not think that the emissions from emergency stacks were subject to the 648 lbs of PM-10 per day (which is based on the SIP limit of 1.2 lbs per dry ton of sludge). Their understanding was that the emergency stack emissions were subject to the facility's total PM-10 emissions, which is 1279 lbs per day.

Incinerators 9 and 10, the southernmost stacks, seem to be most susceptible to wind induced draft according to Mr. Brown. We discussed other possible solutions to the damper leakage. Mr. Brown had explored the option of a double damper system with an air purge. This option, however, costs \$40,000 to \$50,000 per damper, which would total \$1,000,000 for the entire facility. MC does not view this as an option. They also discussed the difficulty of building some type of valve for the stack. At the other multiple hearth incinerator facility, Seneca, they have

installed a structure alongside the stack which supports a cover for the emergency stack that can be open or closed. However, the Seneca stacks are much smaller than MWTP's and they also do not have to abide by any airport height requirements. U.S. EPA suggested the possibility of reducing the stack height to accommodate a cover and also meet the airport height requirement.

They also asked us questions regarding the discovery of these violations and future action. U.S. EPA informed them that much of the preliminary information was passed on from MPCA and that there were three possible options after the 113 conference: an Administrative Order (AO) without penalty (compliance can be achieved within a year and there is no liability); an AO with penalty (compliance can be achieved within a year and penalty is usually less than \$200,000); and a judicial complaint (compliance is long term and penalty is usually greater \$200,000). We left the facility at approximately 5:30 PM.

MULTIPLE HEARTH INCINERATOR OPERATION

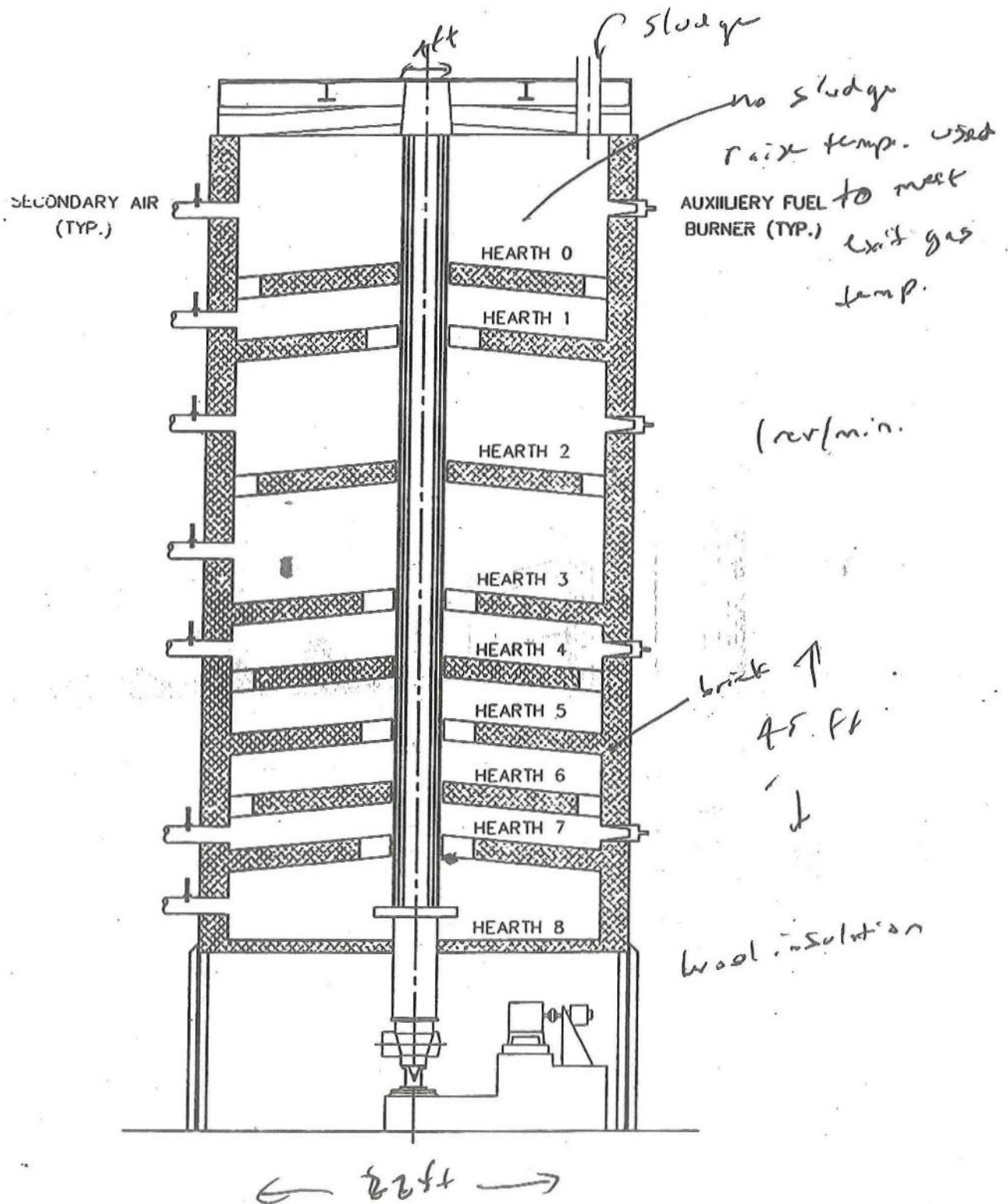
James W. Brown, P.E.

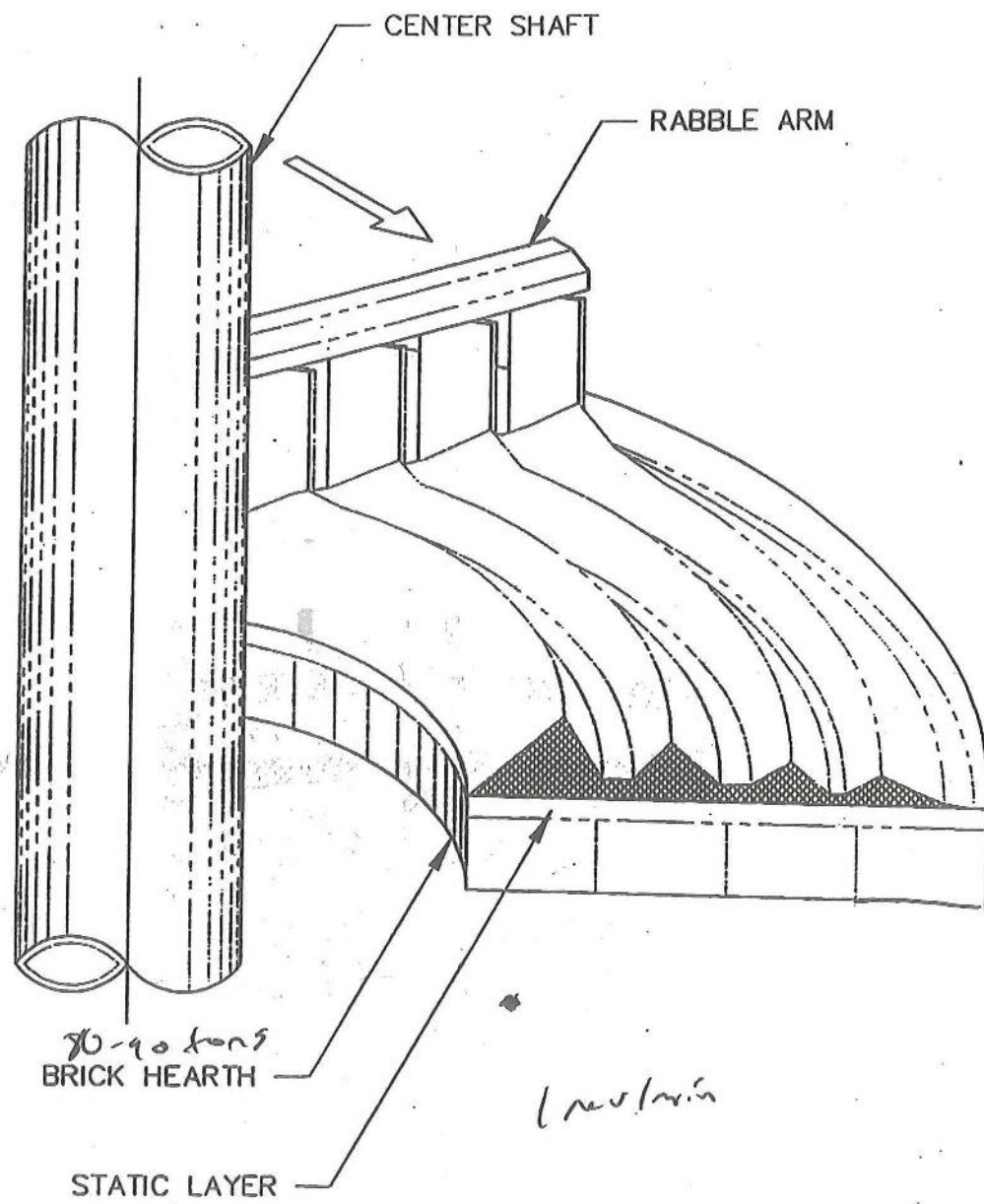
Metropolitan Council Environmental Services

St. Paul, Minnesota

MULTIPLE HEARTH INCINERATION

- * Developed in 1888 for Roasting Ore**
- * Adapted to Burn Wastewater Sludge in the 1930's**
- * Most Commonly Used Type of Furnace for Biosolids Incineration**
- * Consists of a Shell Containing a Series of Circular Refractory Brick Hearths Stacked One Above Another**

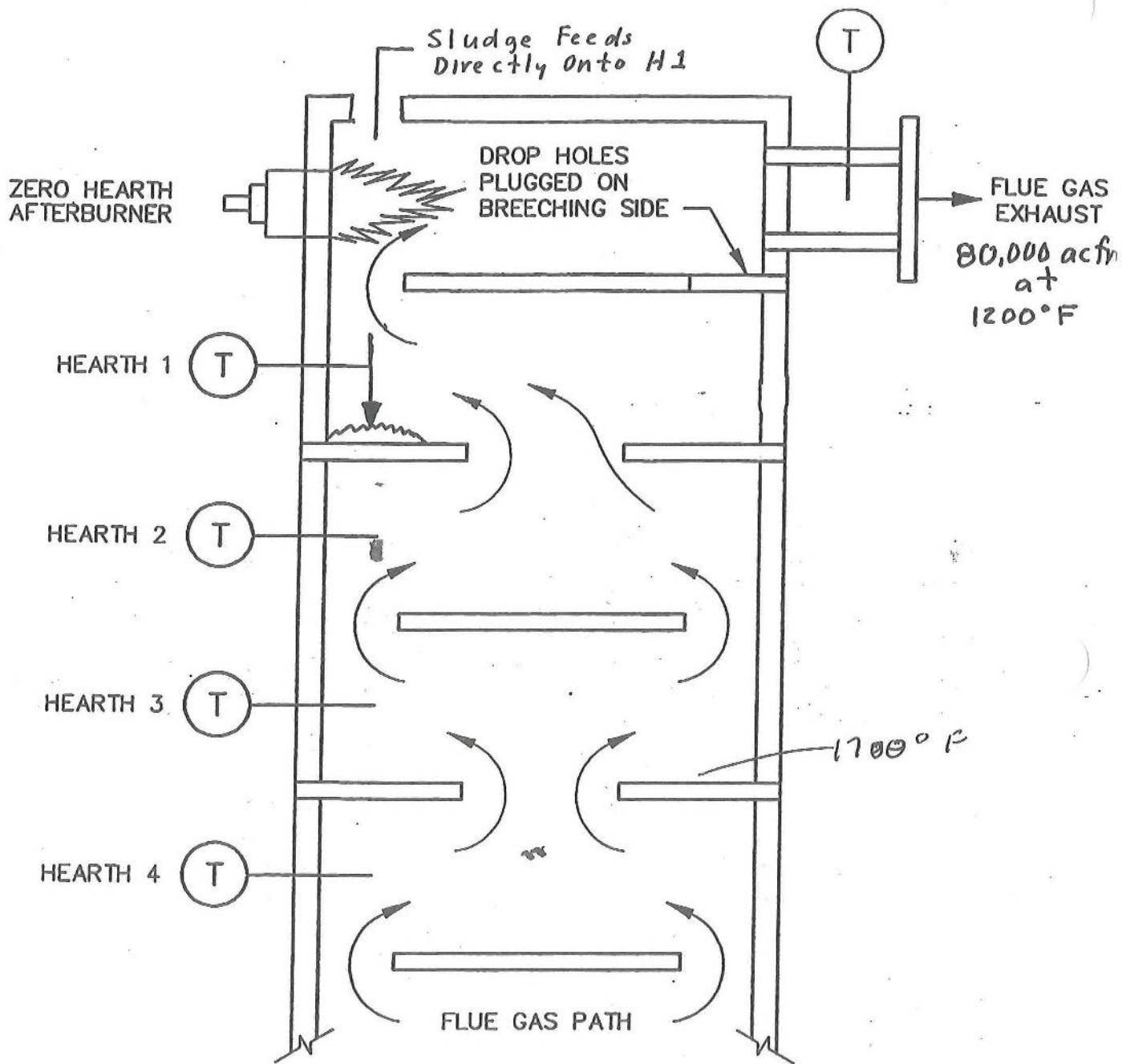




Rabble speed just right.

MULTIPLE HEARTH OPERATION

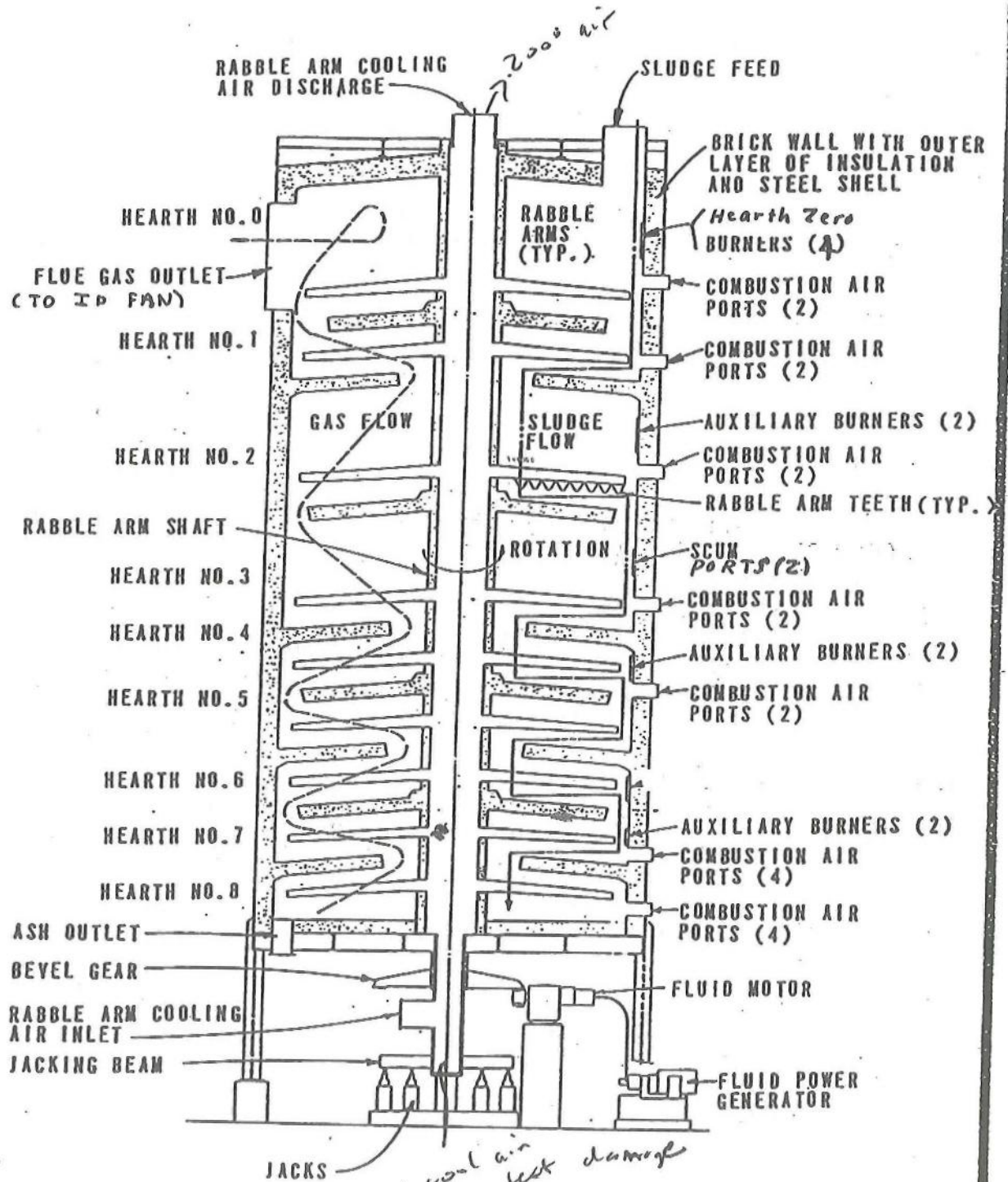
- * MHI is a Large Counter-Current Heat Exchanger *5701-20102 to start burn*
- * Three Process Zones *from hearth 3, 4
hot gas volatilizing on materials, CO, etc
downfall*
 - 1) Drying Zone to Evaporate Excess Water from Sludge
 - 2) Burning Zone *hearth 3, 4 ignition*
 - 3) Ash Cooling Zone
- * Heat Generated in Burning Zone is Transferred to Drying Zone to Evaporate Water *produce lots of flue gas*
- * Availability of Excess Air and Turbulence in the Burning Zone Promotes Complete Combustion and Reduces the Exhaust Gas THC Content
- * *Fluctuations in cake moisture content and in
cake feed rate impact air flow and process stability.*



hearth 2, 3 will continue to combust no matter

Multiple hearth furnace with zero-hearth afterburner
(top hearth is an out hearth).

Nine Hearth Furnace - Metn Plant, St. Paul Mn
(INC 5 → 7, 9 + 10)



relocation of burners

dryer - larger hearths

Polymer testing - so they don't peel

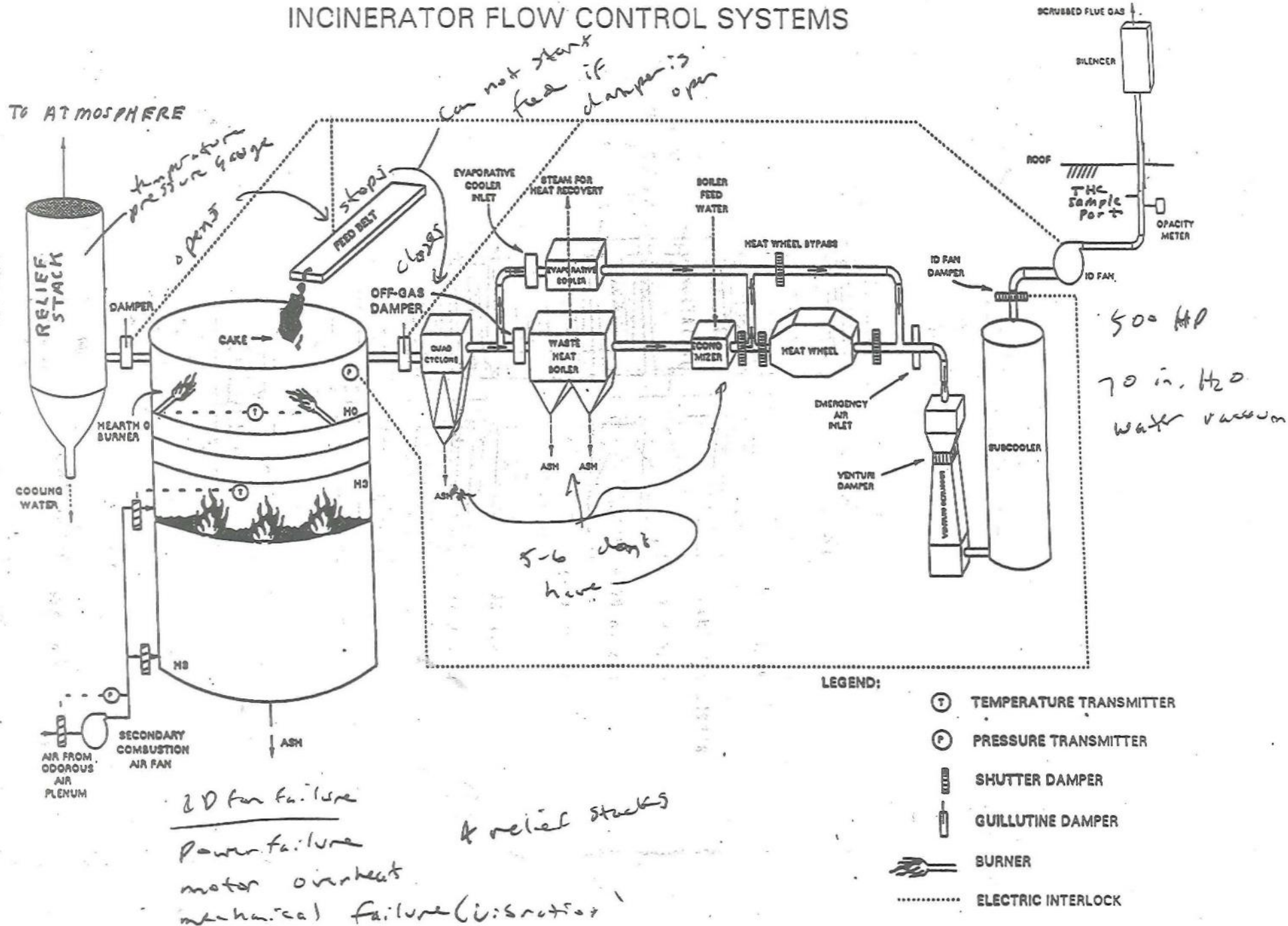
blowbacking are in dewatering

Centrifuges for running for
a month

28-35% solids

2 centrifuges 7

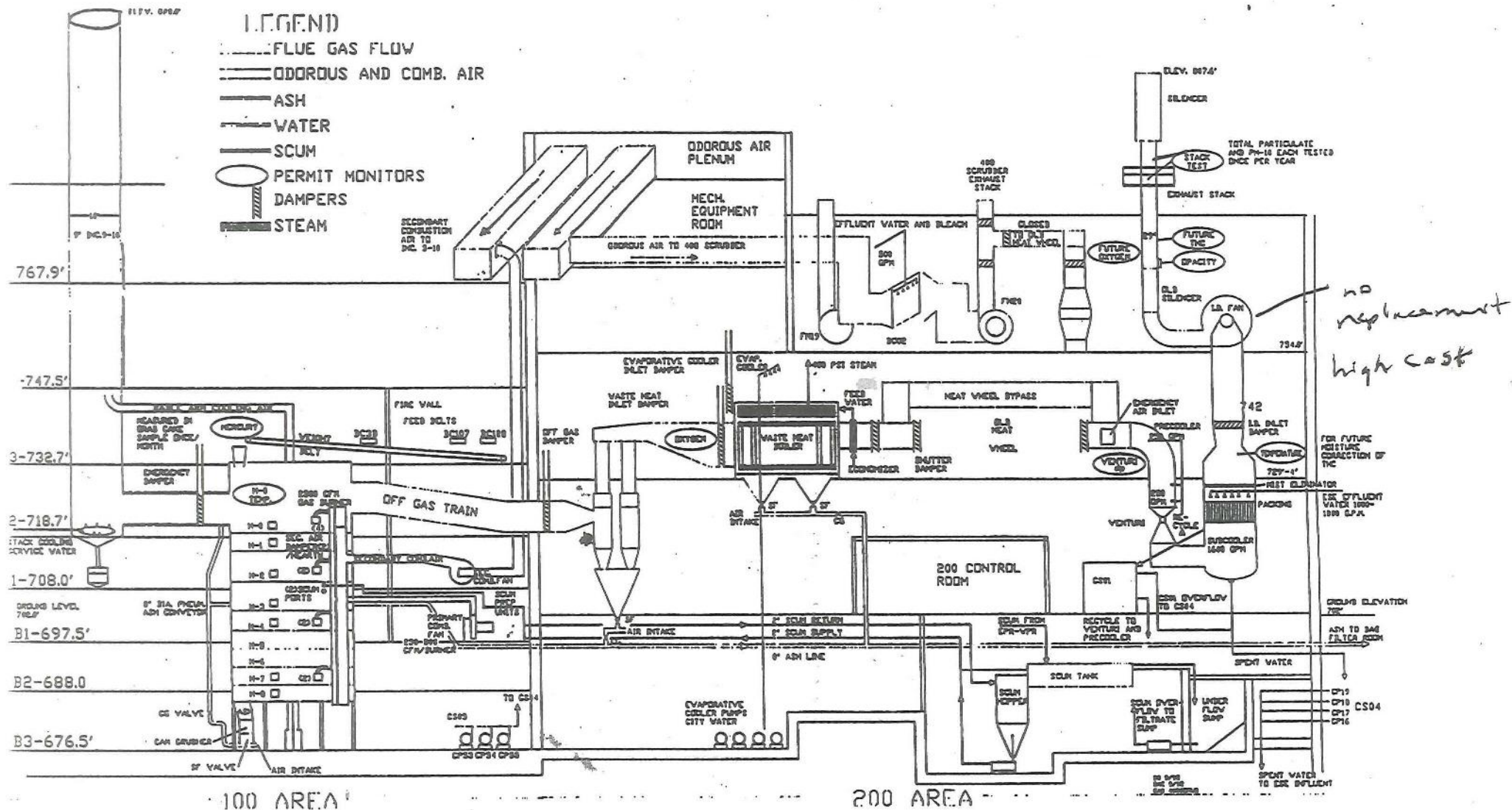
INCINERATOR FLOW CONTROL SYSTEMS



INCINERATOR AND SCRUBBER SYSTEMS

LEGEND

- FLUE GAS FLOW
- ODOROUS AND COMB. AIR
- ASH
- WATER
- SCUM
- PERMIT MONITORS
- DAMPERS
- STEAM



SITUATIONS REQUIRING RELIEF STACK USE

- Power Failure
- ID Fan Motor Overload - h.t., vibrating
- Loss of Draft - 1.2 in. pressure in after burner
50/50 ID fan failure damper opening
- Insufficient Scrubber Water Flows
- Insufficient Hydraulic Pressure - rotate raddle arm
- Flue Gas High Temperature - excess temp. shuts down to protect equipment
- ID Fan Excess Vibration

08/05/96

RELIEFS.DOC

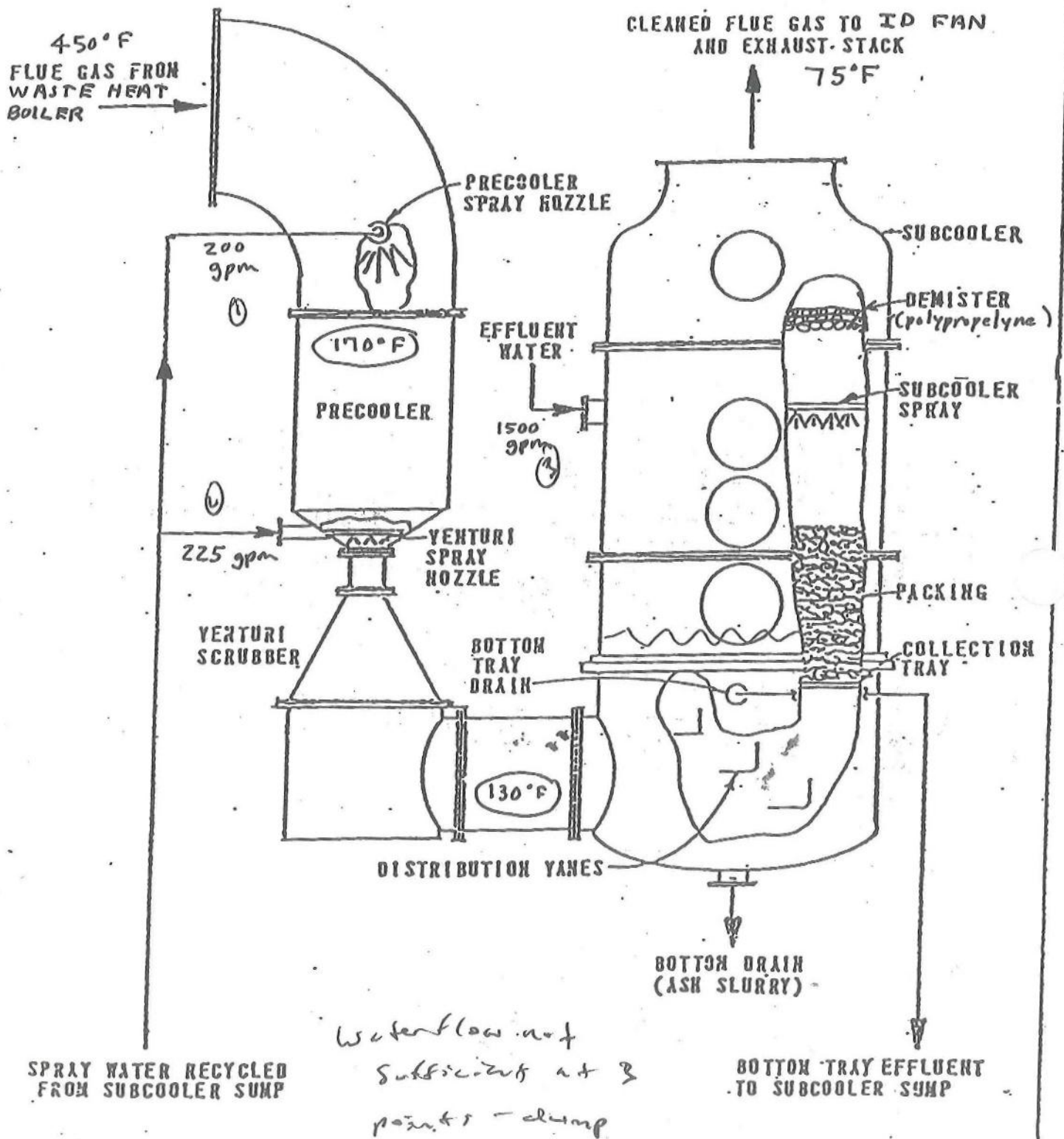
INCINERATOR SAFETY INTERLOCKS

INCIDENT	INSTRU (LOOP REF.)	DWO. NO.	PROG. CONTR IN/OUT NO.	BURNER PERMISS- SIVE	PURGE STATE	MAIN FUELS & PILOT VALVES	STACK INLET DAMPER INC. 6&6 ONLY	DRAFT MODE	FEED PERMISS- SIVE	EMER. BYPASS DAMPER	CYCLONE INLET DAMPER	EMER. PRE- COOLER WATER PRESS.	SECOND. COMBUS- TION AIR DAMPERS	WHRS IN & OUT DAMPERS	EVAP. COOLER INLET DAMPER	I.D. FAN MOTOR	I.D. FAN TURBINE	SCUM BURNER PERMISS- SIVE	RABBLE ARM DRIVE
POWER OUTAGE	—	—	R	OFF	OFF	CLOSE	CLOSE	DUMP	OFF	OPEN	CLOSE	ON	CLOSE	CLOSE IN	OPEN	OFF	OFF	—	—
OPERATOR ACTIVA- TION OF DUMP	—	—	PC	OFF	OFF	CLOSE	—	DUMP	OFF	—	—	—	—	—	—	OFF	—	—	—
HIGH VIBRATION OF I.D. FAN	775VS	614-11	PC	OFF	—	CLOSE	CLOSE	DUMP	OFF	OPEN	CLOSE	—	CLOSE	—	—	OFF	OFF	—	—
HIGH TEMPERATURE VENTURI SCRUBBER	—	614-12 614-52	R/PC	OFF	—	CLOSE	CLOSE	DUMP	OFF	OPEN	CLOSE	ON	—	—	—	OFF	OFF	—	—
LOSS OF DRAFT FOR 10 TO 30 SECONDS	—	—	PC	ON	—	CLOSE	CLOSE	DUMP	OFF	OPEN	CLOSE	—	CLOSE	—	—	—	—	—	—
LOSS OF DRAFT FOR OVER 30 SECONDS	876ZS	614-11	PC	OFF	—	CLOSE	CLOSE	DUMP	OFF	OPEN	CLOSE	—	CLOSE	—	—	—	—	—	—
HIGH TEMP. FLUE GAS ANY OF FOUR	282, 283 281, 270TS	614-11	PC	OFF	—	CLOSE	CLOSE	DUMP	OFF	OPEN	CLOSE	—	CLOSE	—	—	OFF	OFF	—	—
LOW WATER FLOW, PRECOOLER	265FS	614-12 614-52	R/PC	OFF	—	CLOSE	CLOSE	DUMP	OFF	OPEN	CLOSE	ON	CLOSE	—	—	OFF	OFF	—	—
LOW WATER FLOW, SUBCOOLER	264FS	614-52	PC	OFF	—	CLOSE	CLOSE	DUMP	OFF	OPEN	CLOSE	—	CLOSE	—	—	OFF	OFF	—	—
LOW WATER FLOW, VENTURI	069FS	614-52	PC	OFF	—	CLOSE	CLOSE	DUMP	OFF	OPEN	CLOSE	—	CLOSE	—	—	OFF	OFF	—	—
LOW HYDRAULIC FLUID PRESSURE	819PS	614-36	PC	OFF	—	CLOSE	CLOSE	DUMP	OFF	OPEN	CLOSE	—	CLOSE	—	—	OFF	OFF	—	—
INADEQUATE FAN SPEED	875ZS	614-11	PC	—	—	—	—	WILL NOT PERMIT ID MODE	—	—	—	—	—	—	—	—	—	—	—
HIGH FURNACE TEMP 1950° ANY HEARTH	011, 018 020TS	614-30	PC	OFF	—	CLOSE	—	—	OFF	—	—	—	—	—	—	—	—	OFF	OFF
LOW PRESSURE SHAFT AIR IN	801TS	614-30	PC	OFF	—	CLOSE	—	—	OFF	—	—	—	—	—	—	—	—	—	OFF
HIGH TEMPERATURE SHAFT AIR OUT	801TS	614-30	PC	OFF	—	CLOSE	—	—	OFF	—	—	—	—	—	—	—	—	—	OFF
SHAFT STOPPED	801SS	614-30	PC	OFF	—	CLOSE	—	—	OFF	—	—	—	—	—	—	—	—	—	—
LOW PRESSURE BURNER COMB. AIR	817PS	614-02	PC	OFF	—	CLOSE	—	—	OFF	—	—	—	—	—	—	—	—	—	—
HIGH/LOW FUEL OIL PRESSURE	822PS 821PS	614-03	PC	OFF	—	CLOSE	—	—	OFF	—	—	—	—	—	—	—	—	—	—
HIGH/LOW FUEL GAS PRESSURE	823PS 826PS	614-03	PC	OFF	—	CLOSE	—	—	OFF	—	—	—	—	—	—	—	—	—	—
HIGH/LOW PILOT GAS PRESSURE	826PS 825PS	614-03	PC	OFF	—	CLOSE	—	—	OFF	—	—	—	—	—	—	—	—	—	—
ASH GATE NOT FULLY OPEN	811ZA	614-14	PC	OFF	WILL NOT ALLOW PURGE	CLOSE	—	—	OFF	—	—	—	—	—	—	—	—	—	—
LOW TEMPERATURE BURN ZONE	213, 214 215TS	614-14	PC	—	PURGE OK	—	—	—	OFF	—	—	—	—	—	—	—	—	OFF	—
HIGH TEMPERATURE ANY HEARTH	011, 018 020TS	614-30	PC	—	—	—	—	—	OFF	—	—	—	—	—	—	—	—	OFF	—
HIGH LEVEL FEED HOPPER	814, 815 816LS	BEE MTG SCHEM.	R	—	—	—	—	—	OFF	—	—	—	—	—	—	—	—	—	—
LOW SPEED CONVEYORS	808SS 808XS	—	R	—	—	—	—	—	OFF	—	—	—	—	—	—	—	—	—	—
LOSS OF WASTE HEAT BOILER PERMISSIVE	888QS	614-59	R	—	—	—	—	—	OFF	—	—	—	—	CLOSE	614P	—	—	—	—
FUEL VALVES CLOSED	822, 824 825ZD	614-02	PC	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

△ Denotes trigger into dump mode, ○ Denotes loss of this type of permissive control.

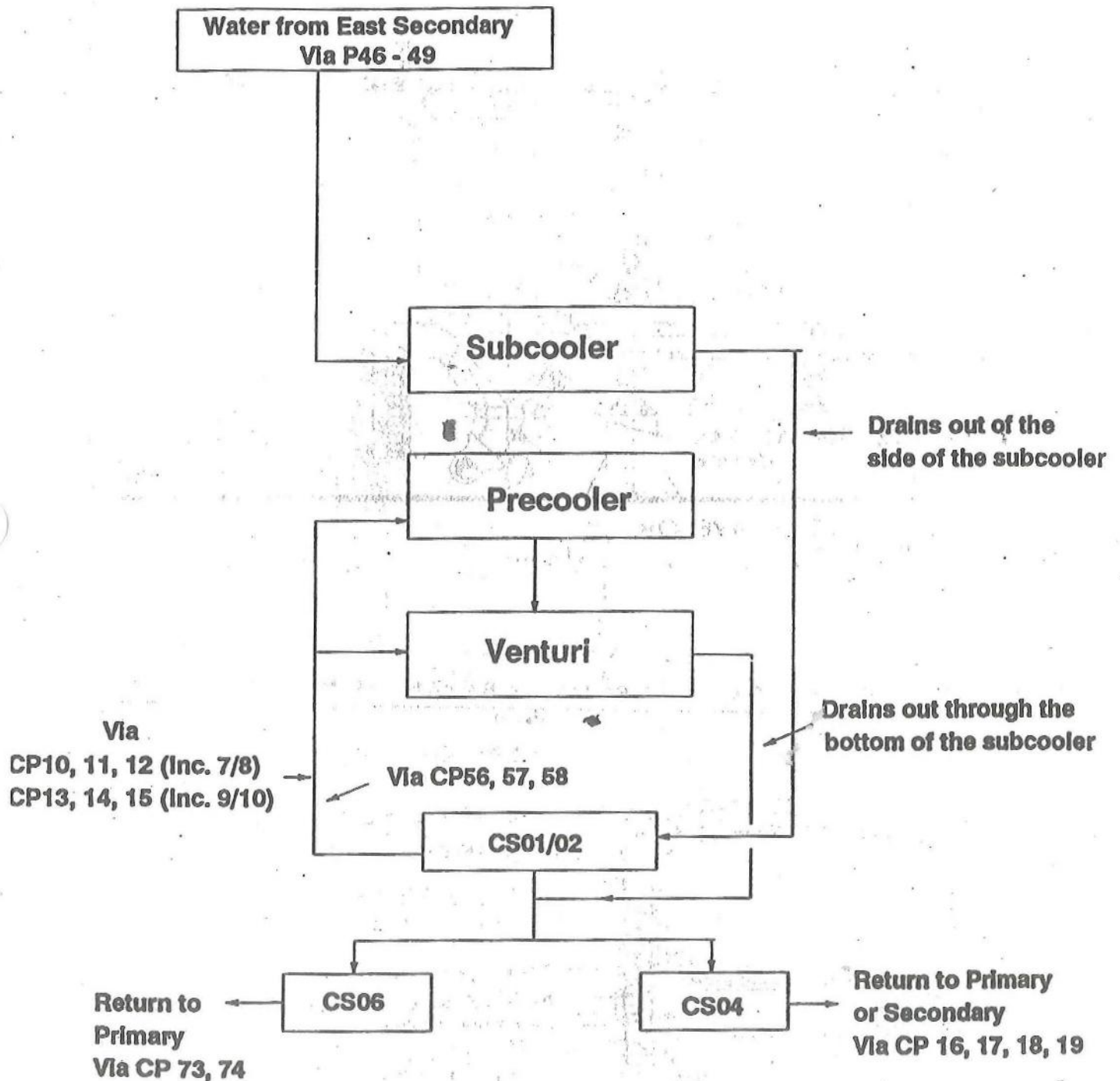
JK 12/92

dump - 30 sec shuts down



VENTURI SCRUBBER / SUBCOOLER

INCINERATOR 7 THRU 10 WATER FLOW



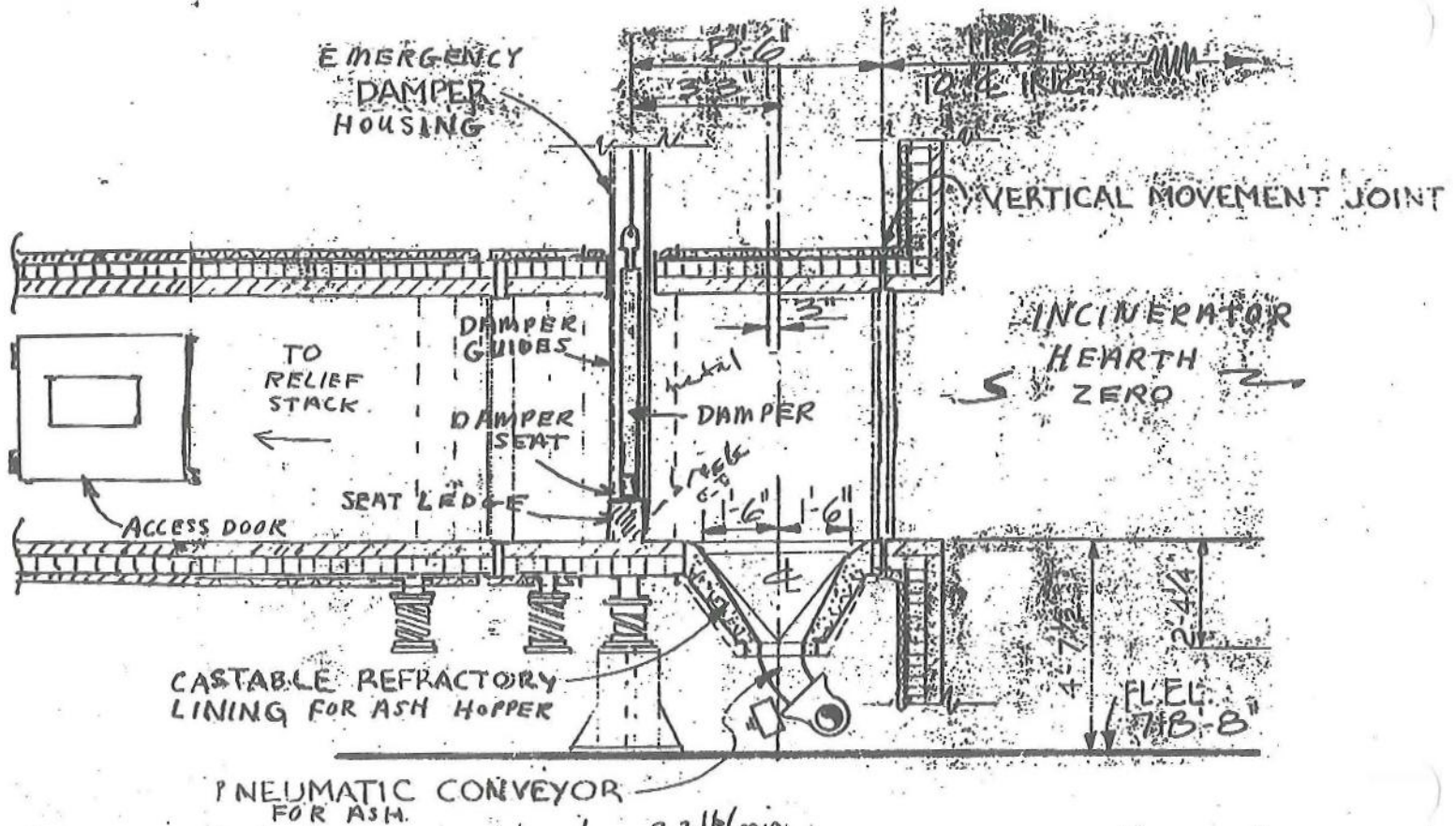


FIGURE 3
VIEW OF EMERGENCY BREACH/DAMPER FROM INSIDE HEARTH

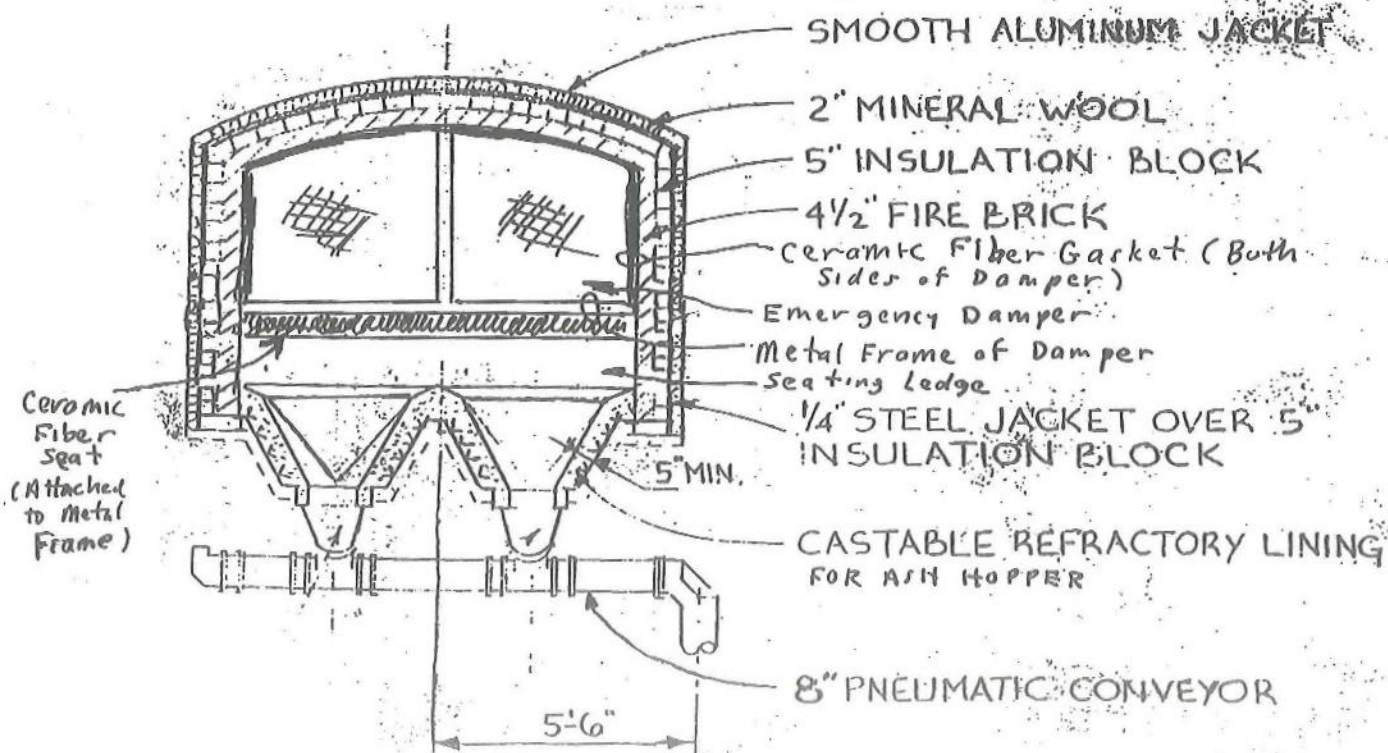
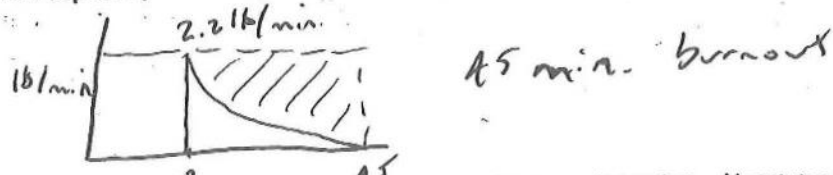
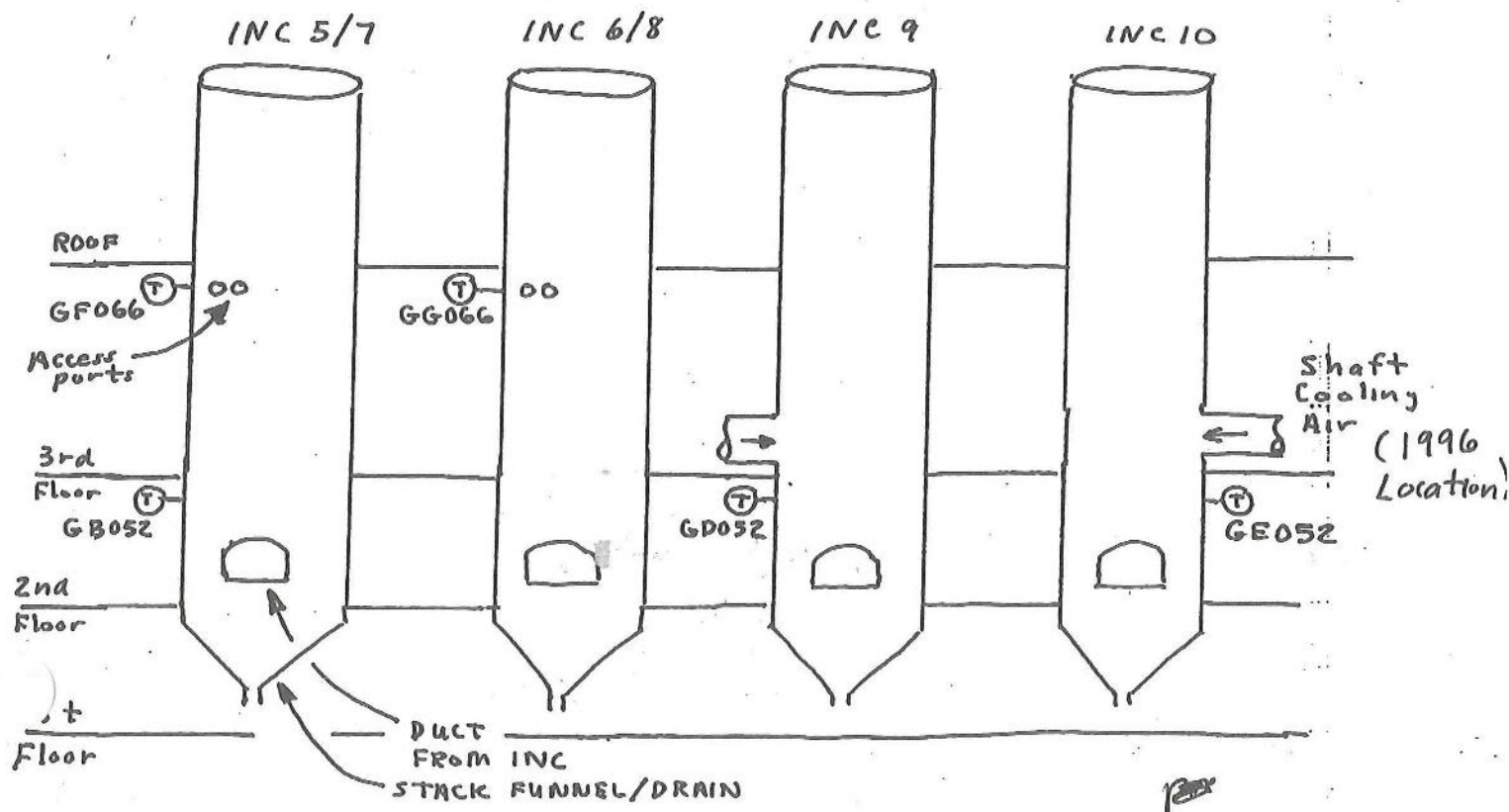


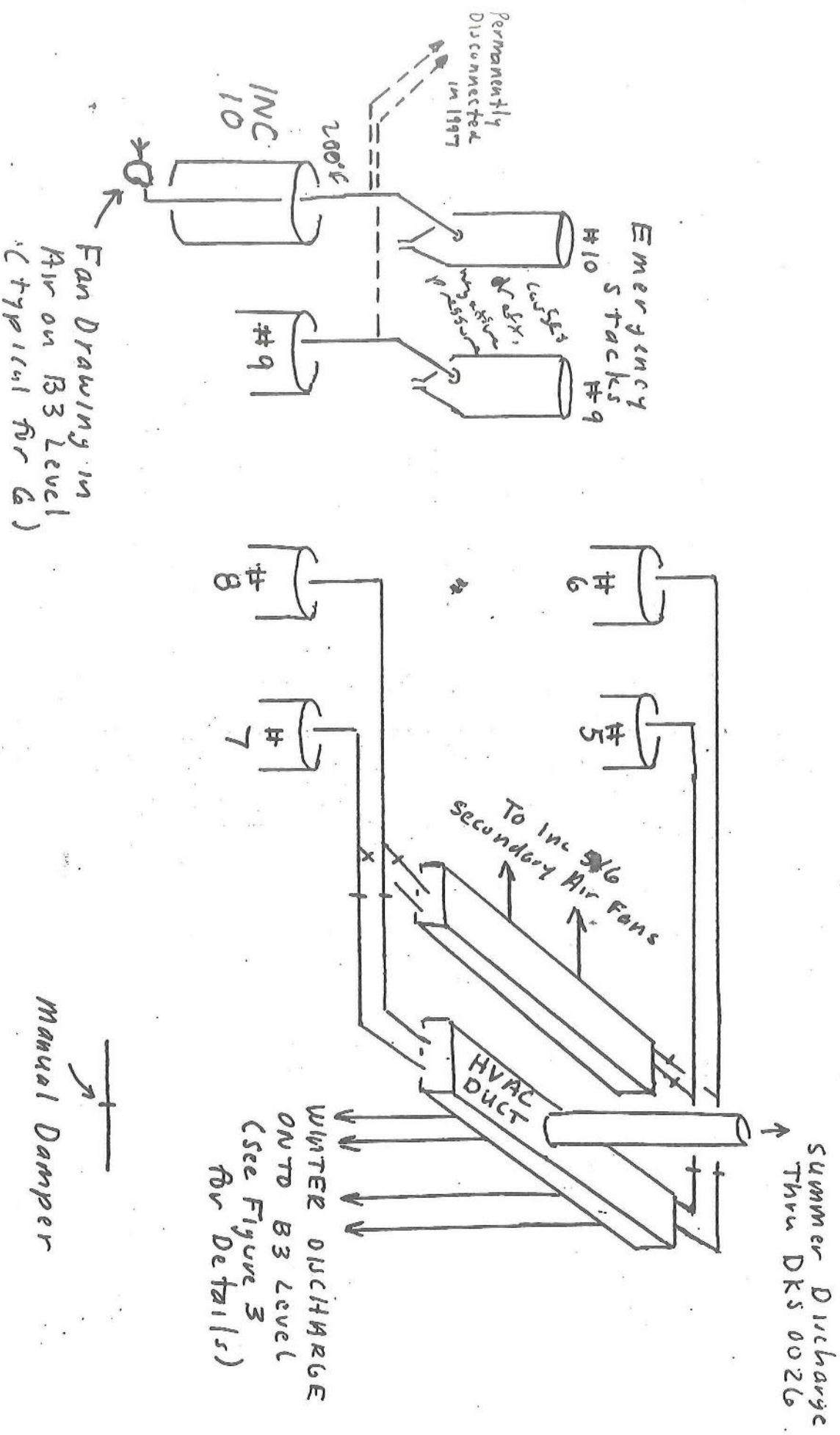
FIGURE 4
THERMOCOUPLES FOR MONITORING
OF RELIEF STACK TEMPERATURES



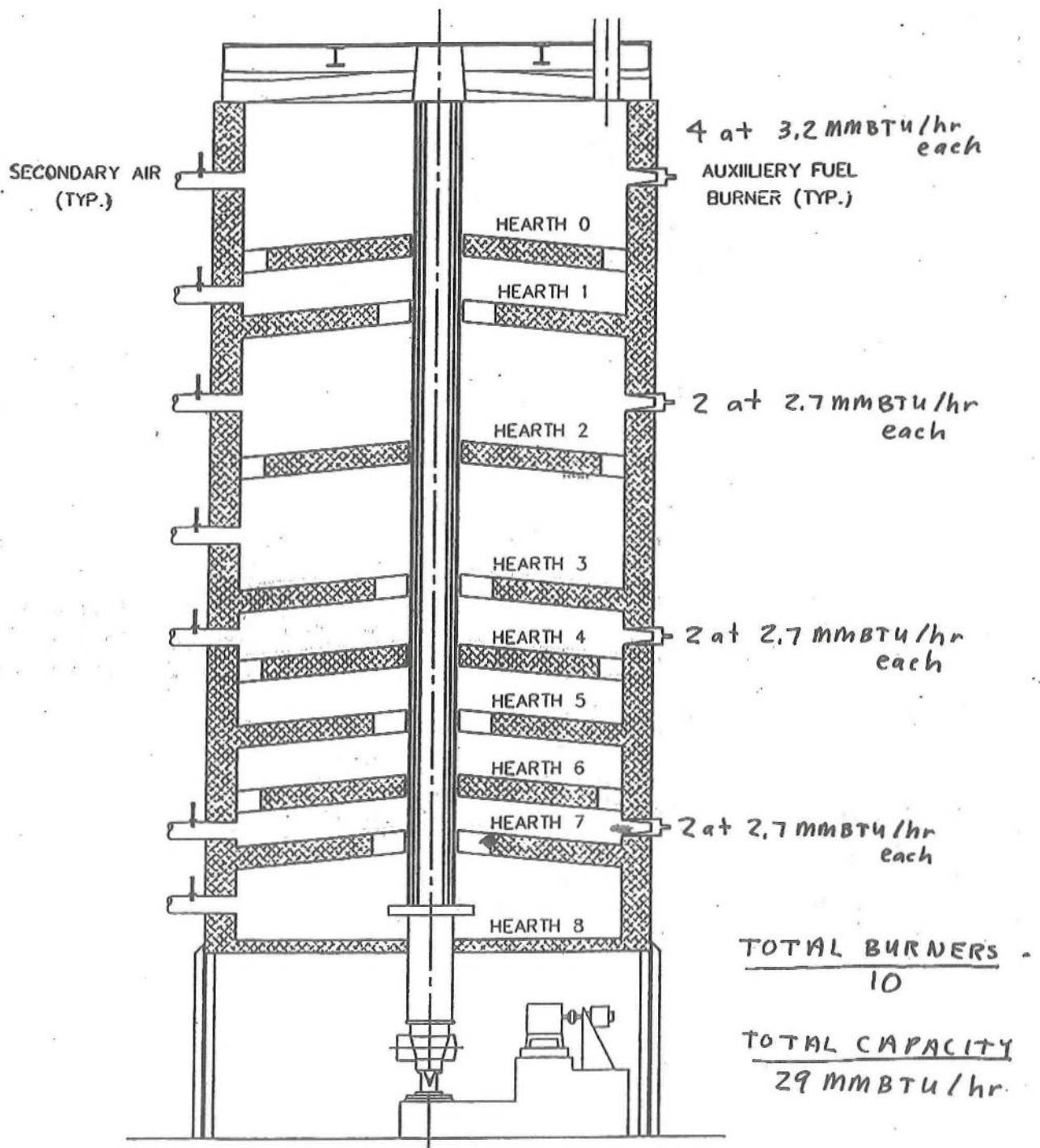
GB 052 T T - 5/7 Stack, top of 2nd floor
 GF 066 T T - 5/7 Stack, below roof line
 GG 066 T T - 6/8 Stack, below roof line
 GD 052 T T - Inc 9 Stack, top of 2nd floor
 GE 052 T T - Inc 10 Stack, top of 2nd floor

Shaft Cooling Air Routing - December 1996

JBrown



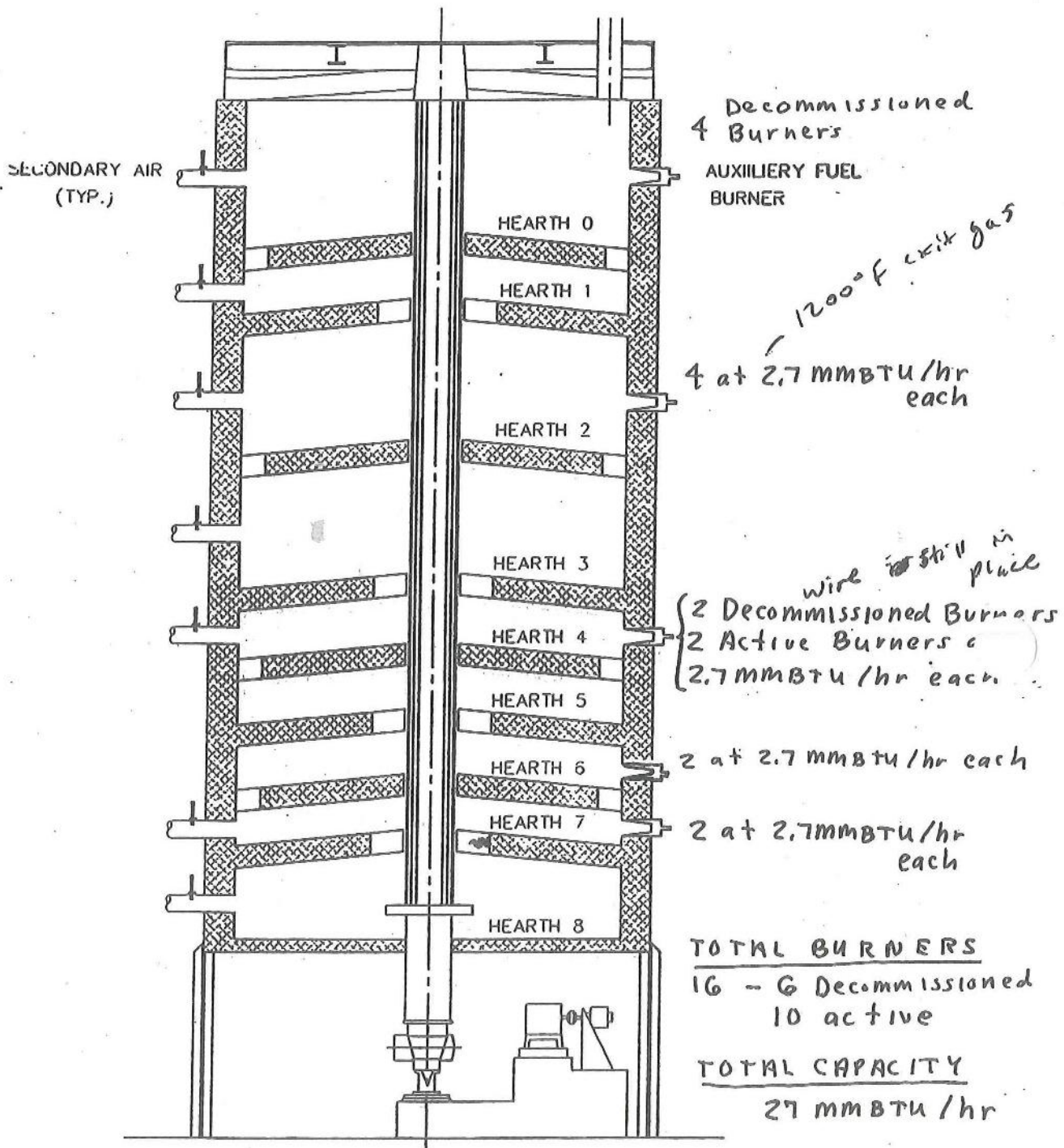
INC 5 → 7, 9 + 10



Incinerator
5 → 7, 9 + 10

cross section.

INCINERATOR #8



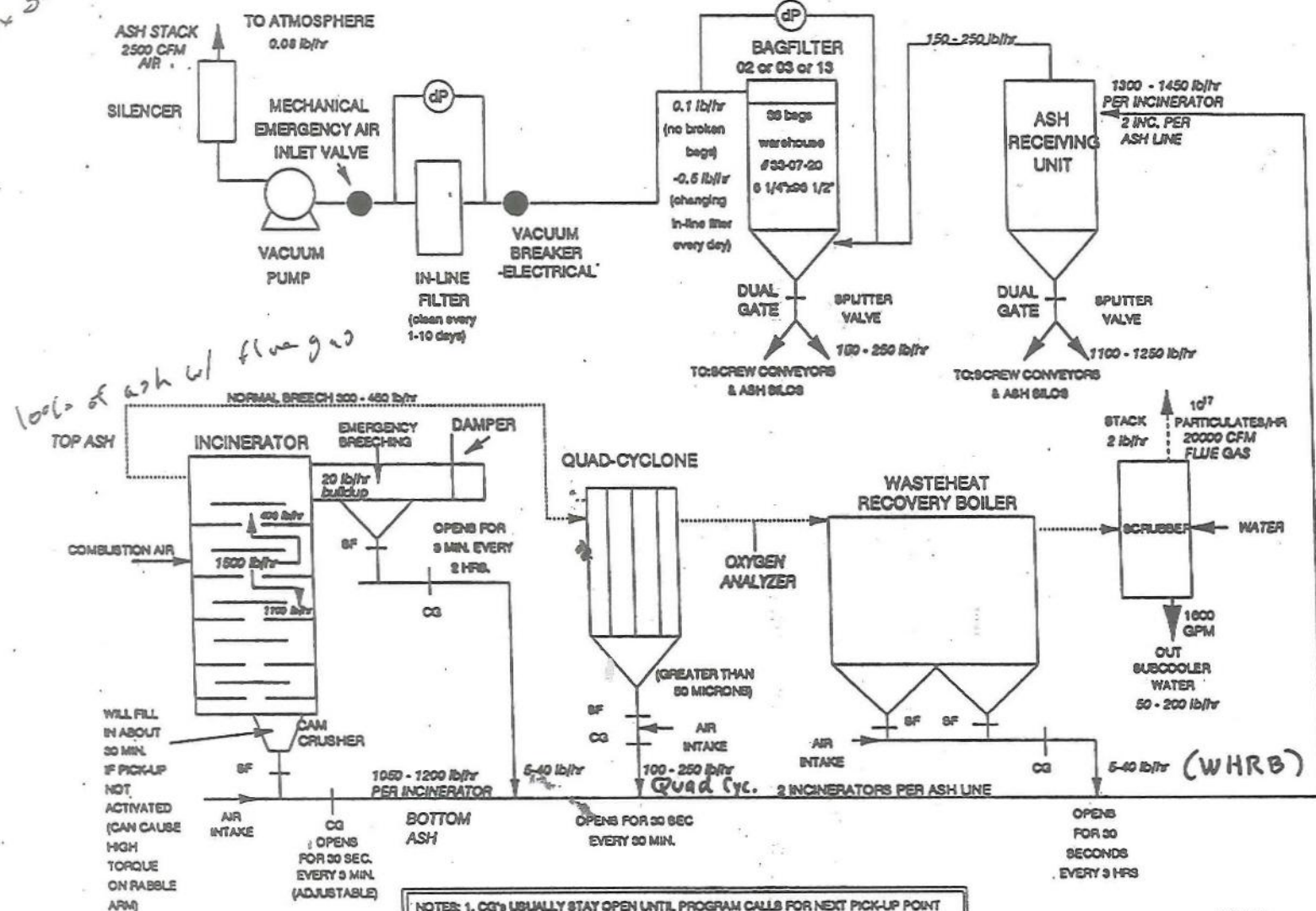
avg. 7 mmbtu/hr
 heating up
 16-17
 is

Incinerator number 8, cross section.

PNEUMATIC ASH SYSTEM

TYPICAL ASH FLOW RATES PER INCINERATOR

*Vacuum pump
max 50-100*



- NOTES: 1. CG's USUALLY STAY OPEN UNTIL PROGRAM CALLS FOR NEXT PICK-UP POINT
2. TYPICAL ASH FLOWS (APPROXIMATE) BASED ON DATA COMPILED BY STEVE GREENWOOD, STEVE BALOGH AND 1800 ASH STACK TEST
3. DRY ASH DENSITY: 43 LB/CUBIC FOOT (UNCOMPACTED) RANGE 30-50 LB/C.F.

HF 2/92
REV DQ, JK 1/93

Purpose of the Incinerator Relief Stack

The presence of relief stacks and dampers is an essential safety requirement for any multiple hearth incinerator. The complexity of incinerator controls and air pollution control trains makes it inevitable that operation of the induced draft fan must occasionally be interrupted. This happens when the fan is unable to withdraw the hot flue gases from the furnace, or when continued flow of flue gas would cause damage to the control train, such as would occur if scrubber water flow were lost. When these interruptions occur, the availability of the relief stack plays a vital role in assuring personnel safety and equipment integrity within the incinerator facility.

With the loss of induced draft caused by a shutdown of the fan, a damper to the relief stack must open to keep the furnace under negative pressure. Although sludge feed stops, the sludge already on the hearths in the incinerator continues to burn and smolder. Unless the relief stack is used, the incinerator will go under positive pressure and discharge hot flue gas and smoke into the incinerator building and sludge dewatering floor through openings such as the drop chutes and hearth doors. The hot flue gases and smoke present a significant employee safety hazard and threat to vital equipment for several reasons, including:

- a. Physical injuries and burns can result from the hot gases (temperatures in excess 1000° F.) being released to employee work areas. Equipment needed to operate the facility, particularly electrical conduit and wiring, can be destroyed.
- b. Physical injuries can result from falls due to limited visibility from the smoke, as well as employee efforts to escape the affected area.
- c. Employees can sustain physical injuries or burns from contact with hot equipment, or melted rubber or plastic.
- d. Injuries can result from fires caused by the release of the hot gases into employee work areas.

The relief stack and damper are indispensable elements of a multiple hearth incinerator system. Without their presence, workers could be injured and incinerator equipment and associated instrumentation could be destroyed by the release of large volume of extremely hot gases into the biosolids handling complex.